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Filbert Blight and Its Control

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Figure 1. A branch from an infected filbert tree showing a number of blighted shoots of current growth. At *a* is shown a young shoot that was killed by bacterial blight shortly after it emerged from the bud. At *b* is shown a diseased shoot infected near the base of the stem. The shoot has broken at the point of infection and is hanging downward. *(After Barss.)*

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BACTERIAL blight, commonly known as filbert blight, is the most widely distributed and destructive disease of filberts in the Northwest. This malady apparently is native to the Pacific Northwest as Oregon and Washington are the only states in which it has been found. The prevalence and destructiveness of bacterial blight varies with the season and the age of the trees, heavy damage being caused in seasons especially favorable for its development. The most severe losses occur in young orchards two to four years old, where the disease frequently causes a death of 10 to 25 per cent of the trees. Although trees more than four years of age seldom die from bacterial blight infection, many buds, shoots, and branches in the tops of older trees are attacked and killed.

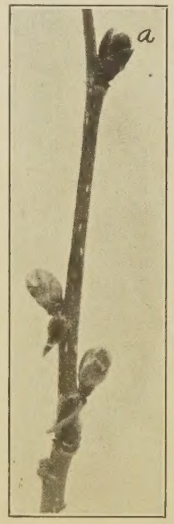

Figure 3. A filbert bud (a) infected with bacterial blight.

NATURE OF THE DISEASE

Cause. Filbert blight is caused by a specific bacterium* that lives parasitically within the tissues. This micro-organism is rodlike in shape with a flagellum or whiplike appendage at one end (Figure 2). The bacteria are so small that they can be seen only with the aid of a high-power microscope.

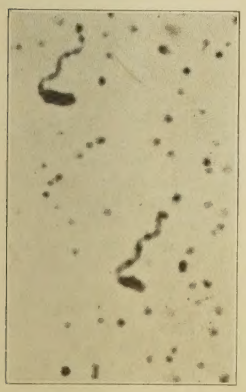

Figure 2. Photomicrograph showing the filbert blight bacterium. *x 2300.*

Description. Bacterial blight affects the buds, leaves, twigs, larger limbs, and trunk of the tree, but does not commonly invade the roots. The nuts apparently are immune as the disease has never been observed on the fruit and attempts to produce a disease of the fruit by artificial inoculation have failed. Indirect reduction in the crop from blight may occur, however, due to the death of many buds, nutbearing twigs, and branches.

Bud infection. Leaf and female (pistillate) flower buds infected with blight turn brown and die before they can open completely (Figure 3).

* *Phytomonas sp.*

As far as is now known, the staminate (catkin) buds are not subject to infection.

Leaf infection. The disease causes angular to irregular shaped, reddish brown, dead spots in the leaf tissue (Figure 4). Leaf infection is of only minor consequence as the disease does not typically cause premature defoliation.

Shoot and twig infections. The first noticeable evidence of infection on shoots of current season's growth consists of dark green, "water-soaked" areas, distributed on the succulent, tender stems. The infected areas later turn reddish brown (Figure 5). A blight infection frequently will encircle the entire stem, causing the leaves at the end of the twig to turn yellow or brown and die. The dead leaves often cling to the girdled shoots for some time, giving them the appearance of having been killed by fire.

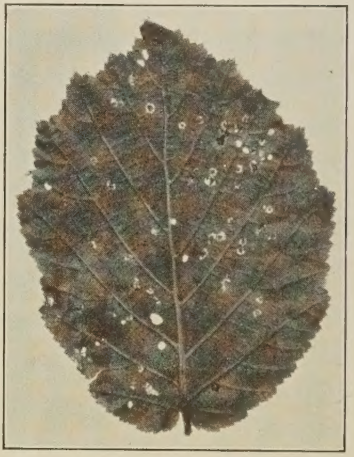

Figure 4. Blight infections on a filbert leaf.

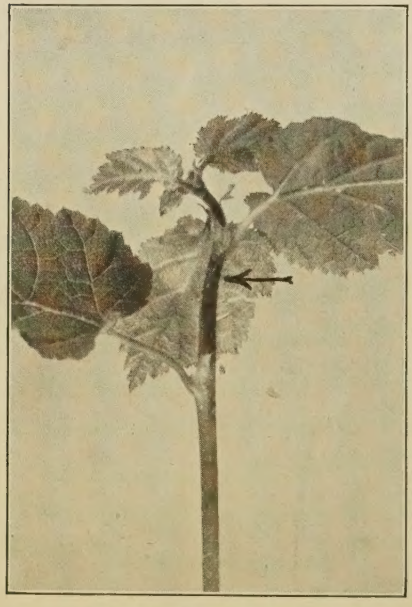

Figure 5. A blight infection, denoted by arrow, on stem of young filbert shoot of current growth.

Infection occurs many times near the base of the stem where an old diseased bud scale was attached to the shoot. If a canker occurs in this region the shoot frequently breaks at the infected point, hangs downward (Figure 1), or falls to the ground during windstorms.

Twigs of the previous year's growth also are attacked and killed by bacterial blight. Infection of one-year-old twigs takes place indirectly either through wounds or by invasion of the bacteria from blighted buds and diseased shoots of current season's growth (Figure 6). The disease causes brown areas in the bark of twigs, frequently girdling the stems and causing them to die. Twig infections vary in color. The diseased areas occasionally have a dis-

tinct reddish-brown cast, but more often the outer bark is only slightly darker than the healthy parts surrounding the cankers. Twigs girdled by blight infections many times will break in the region of the cankers and hang downward. Infection of the twigs is of considerable economic importance as many nut-bearing twigs are killed.

Limb and trunk infections. The formation of cankers on the larger branches and trunk of the tree is the most serious aspect of this disease, particularly when the cankers girdle and kill the trees as they frequently do in young plantings. The disease causes reddish brown to chocolate colored dead areas in the bark (Figure 7). The wood (xylem) is not typically invaded. Branch and trunk cankers sometimes are rather difficult to detect as the outer covering (cuticle) does not change markedly in appearance. If the surface is cut away, however, the canker is detected easily because the diseased tissues are reddish brown to chocolate colored with tiny flecks of white scattered throughout. The infections at first are almost oval in shape with the maximum dimension parallel to the long axis of the branch. They later may become irregular. The size of the cankers varies from one-half to six inches in their maximum dimension. The elevation of the canker at first is unchanged, but as the surrounding healthy tissues grow, the infected areas appear sunken with margins of the canker generally not well defined. Tension resulting from the growth of surrounding healthy parts (Figure 8) may cause longitudinal cracks in the center or at the margins of the diseased areas. The diseased areas frequently girdle the branches or trunk, causing the leaves on the more distant parts to die. The dead leaves often cling to the branches for some time before they fall.

Drops of sticky, slimy matter, containing myriads of bacteria, often ooze out of cankers during periods of high humidity (Figure 8). As this ooze is water-soluble, rains spread the bacteria to susceptible parts below, where, if conditions are favorable, new infections may occur.

The majority of cankers formed in any one year cease active development as soon as dry weather sets in and bacteria in the tissues die. In some cankers, however, the bacteria remain alive throughout the summer and act as sources of primary infection during the fall and spring.

While bacterial blight does not, as a general rule, attack and kill branches that are more than 5 years old, cases are on record of 4-year-old leader branches being girdled and killed by the disease.

Blight cankers and dead areas on the trunk due to sunscald or winter sunburn frequently are confused by many growers. While

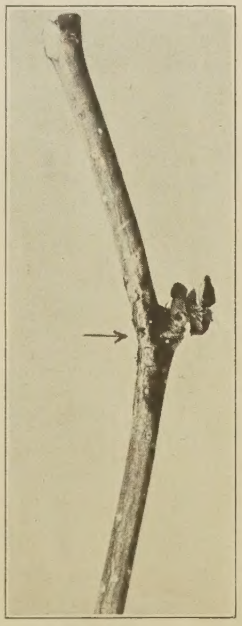

Figure 6. A blight canker, denoted by arrow on a one-year-old filbert twig at the base of a blighted bud.

the only sure way of differentiating between blight cankers and winter sunburn is by a microscopical examination, sunscald generally occurs on the trunks at or near the ground line on the south or southwest side of the tree. Blight cankers will be found scattered irregularly on all sides of the trunk.

LIFE HISTORY OF DISEASE

Overwintering. The blight organism is carried over from one season to the next in branch and trunk cankers, in blighted twigs, and to a lesser extent in diseased buds. Branch and trunk cankers appear to be the most important source of primary infection. The causal organism apparently does not overwinter in the soil as all attempts made to isolate it from soils collected under badly infected filbert trees have been uniformly negative.

Spread. Atmospheric moisture is the most important natural agency concerned in the spread of filbert blight. Man also may spread the disease with tools. Shears or knives used in pruning and suckering may be contaminated readily with the bacteria by cutting through a blight canker. Unless some sort of disinfectant is used the germs may be deposited subsequently on the cut surface of pruning wounds. Insects apparently are not concerned to any significant extent in the spread of bacterial blight.

Figure 7. A blight canker on the trunk of a young filbert tree.

Blight organisms enter through breathing pores and wounds. The disease organisms gain access to the tissues through wounds and also through the natural breathing pores (stomata) in the leaves, buds, and green stems. Blight infections around pruning wounds have been induced by cutting off healthy twigs and branches with shears smeared with pure cultures of the blight organism. Healthy leaves have been artificially infected by spraying foliage of potted filbert trees with sterile water mixed with a pure culture of the blight organism. Microscopic examination later disclosed bacteria in the cavities beneath the breathing pores on the under sides of the leaves. The fact that the blight organism enters healthy tissues through breathing pores appears to be by far the most important information resulting from these studies, as it indicates the possibility of control by spraying.

Time of infection. Results of recent studies appear to indicate that most blight infection takes place in the fall, winter, and early spring. Relatively few new infections seem to occur during late spring and early summer. After midsummer blight infection does not commonly take place.

Seasonal development of the disease. In each of the five years that this disease has been studied in the field, most of the infections on the current growth became evident during the spring, although the disease did not become conspicuous until early summer. By midsummer disease development was largely over.

TENTATIVE CONTROL MEASURES

Surgery. The disease could be eradicated if it were possible to remove all areas of infection by surgery. Such removal is humanly impossible, because the most careful examination fails to locate all sources of infection. Studies carried on over a four-year period, however, appear to indicate that the removal of all detected sources of infection is an aid in the control of this disease. The extent to which it is helpful apparently depends upon the thoroughness in removing sources of infection. Special effort should be made to cut all diseased tissues away. Unless one follows this procedure some of the bacteria will remain in the tissues bordering the cankers, where they will reinfect the tissues and produce new cankers. Blighted twigs should be removed several inches from the discolored margins. In case of cankers on the larger limbs or trunk, all of the discolored tissues must be removed and the cut extended well back into the adjacent healthy bark.

Infected areas must be removed before fall rains if this plan is to be effective, because cutting away diseased areas after infection has occurred is of no value. If the removal of infection sources is delayed until fall or winter the resulting wounds do not heal properly, and are likely to become reinfected during rainy periods unless every cut is protected by a wound dressing containing a germicide. The best time to remove blight infections is in midsummer after disease development is over.

Sanitation. Studies conducted over a period of several years indicate that tree losses from blight traceable to infection from wounds made with contaminated tools can be largely prevented by sterilizing the pruning and suckering tools with some good disinfectant. A very efficient sterilizing solution for both wounds and tools is Reimer's disinfectant. The formula is:

Bichloride of mercury	1 part by weight
Cyanide of mercury	1 part by weight
Water	500 parts by weight

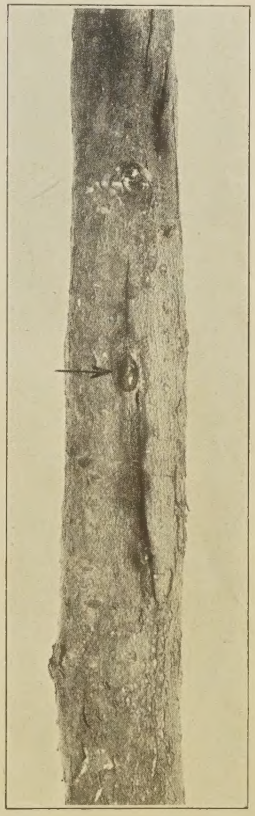

Figure 8. Bacterial ooze, denoted by arrow, coming from a blight canker.

If it is desired to make up one gallon of this disinfectant, dissolve 16 one-half-gram tablets of bichloride of mercury and 16 one-half-gram tablets of cyanide of mercury in 1 gallon of water. Standard-size tablets of these chemicals may be obtained at most drug stores.

This solution should be kept in a glass container as it is corrosive and loses its germicidal properties after coming in contact with metal. The disinfectant will keep indefinitely in a sealed glass container. It is a deadly poison if taken internally and should be labeled and properly guarded.

The use of this sterilizing solution on pruning tools is particularly advisable when suckering and pruning young trees one to four years of age, as infections on the trunks during this period frequently result in the loss of the tree. After a tree is four years of age the use of a disinfectant on tools used in suckering is not so necessary because tissues four years of age or older apparently are highly resistant to bacterial blight infection.

Wounds left when removing sources of infection also should be disinfected with Reimer's solution to prevent reinfection.

Pruning wounds one-half inch or more in diameter and those left after removing diseased parts should be covered with a wound dressing to prevent subsequent infection from bacterial blight and wood-rotting fungi. One of the most efficient and inexpensive wound dressings known is bordeaux oil paint. It is made by stirring raw linseed oil into one of the commercially prepared bordeaux mixtures until a thick, smooth preparation the consistency of house paint is formed. This paint, however, should not be applied to freshly made wounds as the linseed oil may penetrate and kill the tissues bordering the wounds. The cuts should be allowed two or three weeks to dry out.

Spraying. Experiments are now in progress to determine whether timely spraying with a bordeaux mixture will aid in the control of this disease. While several more years of intensive study under a wide variety of seasonal and local conditions will be required before definite recommendations can be made, the results of studies conducted thus far suggest that a fall treatment of bordeaux mixture (4-4-50) applied just prior to leaf fall, but before the first fall rains, will reduce the incidence and severity of the disease appreciably. A bordeaux treatment applied in late winter or early spring when the leaf buds are in the early green-tip stage of development also may be of some value, although this application has not, thus far, proved as beneficial as the fall treatment.

VARIETIES IN RELATION TO THE DISEASE

Filbert varieties differ greatly in the degree to which they are subject to bacterial blight. Of the more important commercial varieties, the Barcelona, DuChilly, White Aveline, and Brixnut are the most severely attacked. The Daviana and Bolwyller seem to possess considerable resistance to blight because they never suffer severely from this disease. Both of these varieties, however, are light bearers.